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FTIR Measurement of Organic Functional Groups in NY/NJ Harbor Sediments

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Beamline(s): U2B

Sediments in urban rivers and estuaries are usually contaminated by a variety of organic and inorganic compounds with natural and anthropogenic origins. Realization of the harm contaminated sediments cause to the environment and human health is now widely recognized and has stimulated interest in programs for their management. The economic consequences of the new management approaches are enormous. In the NY/NJ Harbor case, dredging is required to maintain and improve navigation channels used for commercial purposes. Approximately 1,500,000 cubic meters of dredged material must be dredged and disposed of on upland locations each year. The costs compared to ocean disposal are increased by about 500% with a direct impact on shipping costs. Decontamination and beneficial use of the dredged material may help to ease disposal problems and generate revenue to help contain the overall disposal costs.

Thus, there is a need to understand the properties of these sediments and the organic compounds associated with them. For this purpose, we investigated the functional groups of organic compounds existing in the Harbor sediments. The sediments included National Institute of Standards and Technology Standard Reference Material 1944 taken from different locations in the Harbor and fresh material taken from the Harbor for this experiment. Emphasis was on looking at the most abundant organic materials present with the implicit assumption that contaminant materials will be associated with them. The sediments were pretreated with hydrochloric acid, acetone, hexane, and methyl alcohol to extract the organic compounds and analyzed using Fourier transform infrared spectroscopy (FTIR) at the NSLS U2B beamline. Maps of pretreated sediments showed diversity of functional groups on a micrometer-size scale and revealed that different extraction treatments remove different organic compounds. The figure shows a map of a contaminant (mostly petroleum) spatial distribution after sediment pretreatment with acetone on the left with an optical image of the sediment particle on the right. The map shows that a significant portion of the oil remains on the sediment and that there are differences in adsorption at various locations on the sediment particle. Future work along these lines will attempt to associate particular contaminant compounds with the results observed for the different extractions and with particular molecular weights.

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